

TYPES AND COGNITIVE LEVELS OF QUESTIONS ASKED BY PROFESSORS DURING COLLEGE OF AGRICULTURE CLASS SESSIONS

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Abstract

One common teacher behavior exhibited in college of agriculture class sessions is oral questioning of students. Belland, Belland, and Price (1971) believed that if questioning was a noted teacher behavior, then it was important to evaluate and analyze questions asked by professors. Professors use questions to control classroom interactions, including stimulating the level of thinking which occurs (Blosser, 2000). The purpose of this study was to identify the types and cognitive levels of questions used by selected professors in college of agriculture class sessions. Professor questions were categorized by type and cognitive level. The type of question was categorized using Blosser's classification system which includes managerial, rhetorical, open, and closed questions. The cognitive level of questions was categorized using the Newcomb-Trefz (1987) model which includes remembering, processing, creating, and evaluating levels. Nearly one-half (42%) of the questions asked by the 12 professors in 21 class sessions were closed-type (pre-determined "right" answer) questions. One-third (33%) of the questions asked by professors were remembering (lowest) level of cognition questions. Creating and evaluating level questions were asked least often. It is recommended that professors analyze the types and cognitive levels of their questions, because questions can be designed to fully engage students in the content, and thus, further develop both cognitive skills and content expertise.

Introduction

"A critical purpose of postsecondary education is to prepare students for their future professional lives" (Thompson, Licklider, & Jungst, 2003, p. 133). In that endeavor, Pascarella (2001) considered assessing the practices and processes within a college as a key factor in identifying excellence in undergraduate education. Wilen (1987) stated that, "One of the first steps in the instructional improvement process was to gather data on current behavior and skills as displayed in the classroom setting" (p. 176). Further Nordvall and Braxton (1996) included questioning as one of the other class processes that should be evaluated in examining academic quality.

"All learning begins with questions. Questions cause interaction: thought, activity, conversation, or debate"

(Chuska, 1995, p. 7). Teachers use questions to control classroom interactions, including stimulating the level of thinking which occurs (Blosser, 2000). In a study conducted by Marzano (1993), it was revealed that teachers used questioning techniques to enhance the thinking of students. Sanders (1966) encouraged teachers to prepare questions that would create the type of thinking that was appropriate for a particular course. Therefore, classroom questions should be evaluated and analyzed since questioning is an important teacher behavior (Belland et al., 1971).

Classifying Types of Questions

Wilen (1991) surmised that teachers use questions to deal with both instructional and managerial tasks. Blosser (2000) identified questions as falling into one of four categories: managerial-type, rhetorical-type, open-

type, and closed-type. *Managerial-type questions* according to Blosser are used to deal with class routine. Blosser stated, “*Rhetorical questions* are used by teachers to reinforce a point or for emphasis” (p. 4). *Open-type questions* are those that can have many answers, while *closed-type questions* are the questions which have a specific or limited number of possible responses. Students need to be asked a variety of questions, especially those that develop higher order thinking skills, if they are to successfully solve real-life problems (Blosser).

Cognitive Level of Questioning

Newcomb and Trefz (1987) developed a model for classifying cognitive levels of teacher behavior that simplified the six levels in Bloom’s Taxonomy of Educational Objectives: The Cognitive Domain (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) into four easily interpreted levels. The model can be used in determining the

effectiveness of planning, instructing, and assessing. The Newcomb-Trefz Model identifies the *knowledge level* of Bloom’s Taxonomy as *remembering* (Figure 1). The remembering level requires no understanding of the information, only recall. The next level in the Newcomb-Trefz Model, *processing*, combines the *comprehension*, *application*, and *analysis levels* of Bloom’s Taxonomy. The *processing* level requires the learner to use facts to formulate new answers for given situations. *Creating*, the next level in the Newcomb-Trefz Model is synonymous with the *synthesis* level of Bloom’s Taxonomy. *Creating* requires the development, or making, of some product or idea. The final level of the Newcomb-Trefz Model, *evaluating*, parallels Bloom’s *evaluating* level. When operating at the *evaluating* level, learners must make judgments based on criteria to determine an answer, whether or not there is a set answer.

Bloom’s Taxonomy	The Newcomb-Trefz Model
Knowledge	Remembering
Comprehension	Processing
Application	
Analysis	
Synthesis	Creating
Evaluation	Evaluating

Figure 1. A comparison of Bloom’s taxonomy and the Newcomb-Trefz model.

Purpose and Objectives of the Study

The purpose of this study was to identify the types and cognitive levels of questions asked by professors during class sessions in the College of Food, Agricultural, and Environmental Sciences at The Ohio State University. The following research questions guided the study:

1. What types of questions did professors ask during class sessions as measured using Blosser’s (2000) classification system?
2. At what level of cognition were professors questioning students during class sessions as measured using the Newcomb-Trefz (1987) model?

Methodology

Selection of Participants

The researcher cooperated with the Senior Associate Dean to acquire college support to conduct the study in every department of the College of Food, Agricultural, and Environmental Sciences at The Ohio State University. The Dean sent a letter to all department chairs ($N = 8$) describing the study and asking for their participation. The researcher then met with the department chairs, explained the study using a self-written standardized protocol, then asked the department chairs to nominate three faculty members from their department who were deemed “good” teachers. Good teachers were defined as those who quickly came to mind when the department chair considered exit interviews, student evaluations of instruction, and annual performance reviews. Individual appointments were scheduled with faculty members who were nominated. The study was explained and their participation was sought.

One hundred percent of the nominated professors agreed to participate in the research study. However, given teaching schedules and level of the courses they were teaching, nominated professors were selected whose schedules fit the research time frame. Selected professors were contacted by telephone. During the phone call, professors were informed, using standardized procedure, of the importance of the study, the timeline of the study, and the events that would be taking place during their class sessions. The standardized protocol included general information about assessing the cognitive level of classroom instruction. No specific details, such as measuring types of questions nor measuring cognitive levels of questions, were revealed. Professors were asked if they could be videotaped during the class sessions; all professors agreed to videotaping. Professors were encouraged to contact the researcher via e-mail with further questions or concerns.

Twelve faculty members from seven departments (Agricultural, Environmental, and Development Economics; Animal Sciences; Food, Agricultural, and Biological

Engineering; Horticulture and Crop Science; Human and Community Resource Development; Natural Resources; and Plant Pathology) in the college participated in this study. The Department of Food Science chair nominated only one professor whose class schedule did not meet the timeline. The researcher attempted to observe each participating professors’ class session twice during the quarter of the study. However, three of the professors were observed only once during the study due to conflicting teaching schedules among the professors.

Assessing Participants’ Questions

While reviewing the videotapes of professors’ class sessions, the researcher used a researcher-developed instrument. The instrument was developed using Blosser’s (2002) question classification system to identify each type of question. The researcher recorded frequencies of all managerial, rhetorical, closed, and open-type questions asked by each professor during each class session.

Validity for the instrument was based upon its direct development from Blosser’s (2000) research related to types of questions. Face and content validity were confirmed by a panel of experts from the Department of Human and Community Resource Development at The Ohio State University. Reliability for the instrument was established by assessing a randomly selected videotape of a professor’s lecture, then three weeks later repeating the assessment. The Pearson product-moment coefficient was then calculated. The intra-rater reliability for the types of professor questioning was $r(3 \text{ weeks}) = .88$.

The cognitive level of professor questioning was categorized using the Newcomb-Trefz Model. This model, based on previous research (Bloom et al., 1956), was used to determine the cognitive level of questions asked during class sessions. Using a list of words developed by Newcomb and Trefz (1987) to define the cognitive levels, the researcher developed an instrument to determine the cognitive level of content-related questions asked by professors. The percentage of questions asked at each level of cognition was then determined by dividing the number of

content-related questions at each level by the total number of content-related questions asked by the professor during a class session.

Validity for the instrument was based upon its direct development from Bloom's Taxonomy and the support generally given to the hierarchy of cognitive behaviors. Face and content validity were confirmed by a panel of experts from the Department of Human and Community Resource Development at The Ohio State University. After a three week period reliability for the instrument was established by assessing a sample video for a second time and recording the cognitive levels of questions asked by the professor. The Pearson product-moment coefficient was then calculated. The intra-rater reliability for the cognitive level of professor questioning was $r_{(3weeks)} = .67$. The researcher deemed the reliability of .67 satisfactory to continue, as Nunnally and Bernstein (1994) argue that modest reliabilities can be used in early stages of investigation.

Findings

Findings for Type of Questions

Table 1
Frequency of Question Types (Blosser, 2000)

Type of questions	<i>f</i>	Minimum	Maximum	Range	%
Managerial	158	2	40	38	20.8
Rhetorical	184	2	30	28	24.2
Closed	317	3	87	84	41.6
Open	102	0	39	39	13.4
Total	761				100.0

Note. Twenty-one class sessions were observed for twelve professors

Excluding all managerial (158) and 18 of the 184 rhetorical-type questions, which did not elicit higher cognitive levels of student thought, 585 questions were included in the data analysis for

As can be seen in Table 1, professors asked a total of 761 questions during the 21 class sessions observed. The most common type of question asked during selected college of agriculture class sessions was the closed-type question ($n = 317$), which was asked nearly 42% of the time. One professor asked three closed-type questions while another professor asked 87 (range = 84) closed-type questions. Rhetorical ($n = 184$) and managerial-type ($n = 158$) questions were asked the next most frequently. One professor asked two rhetorical-type questions while another professor asked 30 (range = 28). Rhetorical-type questions accounted for approximately 24% of the professors' questions. One professor asked two managerial-type questions while another asked 40 (range = 38). Managerial-type questions accounted for nearly 21% of the questions asked by professors during observed class sessions.

Open-type questions were asked least often ($n = 102$). One professor asked no open-type questions while another asked 39 (range = 39). Open-type questions accounted for approximately 13% of the questions asked by professors during class sessions.

cognitive levels of professor questions. In Table 2, the frequency and percentage of questions asked at each cognitive level during class sessions are exhibited.

Table 2
Frequency and Percentage of Questions Asked at Each Cognitive Level

Cognitive level	<i>f</i>	Minimum	Maximum	Range	%
Remembering	248	4	58	54	32.6
Processing	198	1	45	44	26.0
Creating	26	0	7	7	3.4
Evaluating	113	0	36	36	14.8
Total	585				76.9
Excluded questions	176				23.1
Overall Total	761				100.0

Findings for Cognitive Levels of Questions

Nearly 33% of the questions assessed for cognitive level were asked at the remembering level ($n = 248$; range = 54). Processing questions ($n = 198$; range = 44) accounted for 26% of the total questions asked during the class sessions. Approximately 15% of the questions asked during class sessions were asked at the evaluating level ($n = 113$; range = 36) of cognition. The remaining 3.4% of the questions were asked at the creating level ($n = 26$; range = 7) of cognition.

Findings from Observations

In Table 3 the frequency of question type used by each professor is shown, while in Table 4 the percentage for each cognitive level asked by each professor during the observed class sessions is shown. Both tables are discussed simultaneously. Professor A asked mostly managerial-type ($n = 24$) questions and zero open-type questions, yet nearly one-third of the questions asked were at the creating level. Professor B asked 36 closed-type questions and consequently nearly three-fourths of the questions asked were at the remembering level.

Professor H asked only 16 questions during the class session, but 61% were at the highest (evaluating) level of cognition. Professor H asked the highest percentage overall of evaluating level questions, followed by professor L who asked more than one-half of the questions at the highest level of cognition. Interestingly, professor L asked 20 open-type questions during the class session.

Professor D, F, and L asked the highest number of open questions (39, 23, and 20 respectively) while professors A, G, and H asked zero open-type questions. Professors C ($f = 134$) and D ($f = 127$) asked the highest frequency of questions overall while professor H ($f = 16$) asked the fewest questions. Professors B and K asked approximately 75% of their questions at the remembering (lowest) level of cognition. Professor A, E, I, and S asked approximately 50% of their questions at the remembering level.

Professor G asked approximately two-thirds of the questions during the class session at the processing level, while professor D asked approximately 50% of questions at the processing level. Eleven professors asked fewer than 10% of their questions at the creating level.

Table 3
Frequency of Question Type by Individual Professor

Professor	Type of question (Frequency)			
	Managerial	Rhetorical	Closed	Open
Professor A	24	5	17	0
Professor B	3	4	36	7
Professor C	24	18	87	5
Professor D	40	30	18	39
Professor E	5	17	13	2
Professor F	9	29	11	23
Professor G	22	11	11	0
Professor H	2	11	3	0
Professor I	3	13	15	2
Professor J	7	19	50	1
Professor K	13	25	51	3
Professor L	6	2	5	20

Note. Professors D, H, and L were observed only once during the study.

Table 4
Cognitive Level of Questions Asked by Individual Professor

Professor	Cognitive levels of questions (Percent)			
	Remembering	Processing	Creating	Evaluating
Professor A	50	18	32	0
Professor B	70	24	6	0
Professor C	26	37	4	33
Professor D	17	54	8	21
Professor E	59	38	0	3
Professor F	32	30	0	38
Professor G	23	68	9	0
Professor H	31	8	0	61
Professor I	48	28	7	17
Professor J	56	33	0	11
Professor K	78	19	2	1
Professor L	19	26	0	55

Conclusions

Professors in the study asked primarily closed-type questions during class sessions. Managerial, rhetorical, and open-type questions were rarely asked.

Professors in this study primarily questioned students at the remembering level of cognition. Professors asked evaluating level questions occasionally. Creating level questions were rarely used.

Discussion and Recommendations

Types of Questions

Professors who are using various question types during class sessions are enabling students to practice a wide range of thought processes. If professors continually use one particular type of question, students'

thinking may not be challenged at the higher cognitive levels (Blosser, 2000). Therefore, professors must be made aware of the types of questions they are using during class sessions (Blosser), the purpose for using the various types of questions, and the amount of time needed for students to process different types of questions. For example, when professors ask open-type questions that require students to formulate answers on their own, the amount of time needed for students to think will be greater than when a simple closed-type question is asked that requires little or no processing. Allowing time for students to formulate responses will condition students to spend time on processing the questions. The use of multiple types of questions is recommended during class sessions for greater interaction with the course content.

The types of questions asked during class sessions need to be well-thought, meaning that professors must take the initiative to pre-plan the types of questions required during class sessions to reach the stated objectives. Students who are bombarded with managerial-type questions may become bored. Students who are not given adequate time to truly process a rhetorical-type question, soon cognitively disengage from the content. Students who are frequently asked closed-type questions learn to value the easy recall of facts. If the question is worth asking, even a rhetorical question, then students must be given the opportunity to process that which was asked and to formulate a response. In addition, allowing students adequate time to process the question and to formulate a response, before calling upon them to respond verbally, provides comfort which breeds confidence, and therefore encourages further development of thinking skills.

Cognitive Level of Questions

The cognitive level of each question asked during class sessions needs to be assessed by the professor. Lower cognitive level questions require students to recall information learned in the past, whereas higher cognitive level questions require students to process and potentially evaluate the subject matter. Therefore, professors who ask questions mainly at the remembering level are not encouraging students to critically examine the content being taught. Remembering level questions need to be asked during class sessions for the purpose of providing feedback to the professor regarding understanding of basic foundational information. However, the questions asked need not stop at the remembering level, even in introductory courses. Students need to be required to think critically about the subject by creating their own responses and evaluating criteria pertinent to the questions being asked by professors. The use of various cognitive levels of questions is recommended during class sessions for greater development of cognitive skills.

Professors must begin to challenge students at the creating and evaluating levels

of cognition during class sessions, so that students think-through topics rather than recall information. When a professor asks a question, and half of the students' hands are raised to answer, it is satisfying to know that students "learned" the content, but when no "real" thinking was involved in processing the response, one wonders, "What was the purpose for the question?" and "Can students explain the answers just given?". At some point, students will be expected to explain their understanding of the topic, and unless they have previously been given opportunities to dialogue about the topic, students will realize that their understanding may be superficial. By asking students to create and evaluate, professors encourage deeper thinking about the content, and thus further develop students' lifelong thinking skills.

Summary

Professors who use multiple types of questions during class sessions are allowing students to become engaged in the content. Blosser (2000) contends that, a higher potential for engagement occurs if the professor is aware of, and understands the types of questions being asked during class sessions.

In addition, requiring students to operate across the cognitive levels allows them to further develop cognitive skills. According to Newcomb and Trefz (1987), by understanding the level of cognition of the questions asked during class sessions, professors are able to challenge students at various levels of cognition. Therefore, professors who understand their current use of question types, and cognitive levels of questions, have greater potential for making changes that enhance student learning during class sessions. Researchers (Boggs, 1995; Paulsen & Feldman, 1995; Stevens, 2001) have reported that teaching at the university level has not changed with the times, and that there is a need for improvement in current trends. University teaching can be influenced by the types and cognitive level of questions being asked during class sessions. Blosser believed that teachers must analyze the types of questions asked during instruction

to reach students at higher levels of cognition.

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